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A RECONNOISSANCE OF THE GREENLAND INLAND ICE.

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From the year 1728, when the commandant of a proposed fort on the east coast attempted to ride across Greenland, and was turned back almost at the outset of his journey by an impassable desert of ice, the interior of that country has been a source of curiosity and interest to travellers and scientists, and of superstition and terror to the natives. Becoming interested in the subject at a time when official duties gave me an opportunity to devote some study to it, I became possessed with the desire to see for myself, and put to the test of actual practice and observation certain ideas which had forced themselves upon me. The Navy Department having granted my application for leave, I made the necessary arrangements and left St. John's, N. F., on the steam-whaler *Eagle*, Capt. Jackman, and landed at Godhavn, Disco I., June 6, 1886. The aim of my summer work was, as stated in a paper read before the Washington meeting of the National Academy of Sciences, "to gain a practical knowledge of the obstacles and ice conditions of the interior; to put to the test of actual use certain methods and details of equipment; to make such scientific observations as might be practicable; and to push into the interior as far as possible." My plan, in outline, was to gain the border of the interior ice at some point as near the

N. E. angle of Disco Bay as possible, my preference being the base of Noursoak Peninsula, and then take a course towards Peterman's Mt. on the east coast. But for various reasons I was obliged to modify my plans.

My sledging equipment was made in the lightest and most thorough manner, under my own supervision, and entirely without reference to the use of dogs. The principal items were two nine-foot sledges, thirteen inches wide, made of hickory, steel, and hide, on a modified Hudson Bay pattern, and weighing complete, with dragropes and lashings, twenty-three pounds each; small jacketed alcohol stoves, nine-foot double-ended ash alpenstocks with steel point and chisel, rubber ice-creepers, snow-shoes, snow-skates.

Rations consisted of tea, sugar, condensed milk, hard bread, pemmican, cranberry jam, baked beans, Liebig extract, and an experimental mixture of meat, biscuit, and desiccated potato, put up in two-pound cans by Richard & Robbins, of Dover, Delaware.

Without going into preliminary details, at midnight of June 23d an oomiak and two attendant kayaks containing eight natives, my friend Christian Maigaard, assistant governor of Ritenbenk, myself, and my equipment, rounded the southern extremity of Arveprins I., in Disco Bay, and headed across the mouth of Ikaresak Sound for the entrance of Pakitsok Fjord. Above us the clouds were heavy and leaky, and ahead every depression of the dark mountains and the underside of the black cloud canopy above them was lit up with the pale cold glare of the "ice-blink." *

* Both the native and the Danish colonists almost always refer to the inland ice as the "ice-blink," and I follow their custom.

Entering the narrow-mouthed, bluff-walled fjord, we pulled past a small native settlement, and landed and turned in. The next evening, after a reconnoissance of the upper fjord from a mountain near the camp, we pushed off just at the turn of the tide, and entered the narrow cañon which separates the upper from the lower fjord, said by the natives to be impassable except at certain stages of the tide. One wall of the cañon was glowing in the brilliant yellow sunlight which poured in a level flood through the western entrance; the other lay in deep purple shadow; between them flowed the strong deep-green current, and through the cañon the upper fjord, known to the natives as Illartlek, gleamed blue, and the summits of the inner mountains were soft with yellow light. Beyond the cañon the fjord expanded into a broad lake, contracting again several miles farther up. Above this point the water was pale green, rapidly growing shallow, whiter, and fresher.

At six A.M. we landed just east of the glacier river, which came down from the ice in numerous shallow streams, traversing a broad, level gravel-floored valley, and fell over a natural rock dam into the fjord. Looking up this valley, once occupied by ice, and once evidently an extension of the fjord, the aspect of the ice, now some three miles distant from the fjord head, was the reverse of encouraging. The next night I spent in a reconnoissance along the crest of the huge mountain dam which holds the inland ice in check. An examination of the main ice-tongue, showed that it was utterly impracticable either to ascend its vertical face, or to travel upon its surface; which, studded with huge shark-tooth pinacles of blue ice, stretched upward in a series of terraces

separated by vertical blue cliffs, seamed and broken like walls of basalt. From the summit of one of the main peaks of the dam 2,800 ft. high, commanding the coast line of the "ice-blink" for several miles, I discovered a small tongue of ice curving down into an elevated valley, its surface crevassed and serrated in places only, and its apex, though ragged and precipitous, apparently scalable.

From the root of the tongue, the rolling ice-hummocks stretched eastward out of sight, over the round of the "ice-blink." I climbed along the mountains, a friendly snow-drift affording a passage from the rocks to the surface of the "ice-blink." Then descending along the tongue and down the ragged face, I mapped out roughly a route which should avoid the utterly impassable portions, and then returned to the tent four miles distant. It was necessary to carry the sledges, provisions, and equipment over the rocks to the ice-foot on our backs, and before this was completed, six of my natives deserted me on the plea of sickness, and returned to Ritenbenk, leaving the rest of the work to be done by Maigaard, myself, and two natives, one man and one woman. In spite, however, of this diminution of my force, we got every thing up to the ice-foot, 1,155 ft. above the sea; and at one A.M., of the 28th, the weather having changed from stormy to clear and cold, Maigaard, Frederick the Esquiman, and myself ran the slender nine-foot sledge, which we had christened "Sweetheart," on to the ice, and we began the upward climb. The steep slope was traversed by ridges, gullies with nearly vertical walls, cracks and crevasses of all widths. The trend of these crevasses and gullies was nearly at right angles to our course, and they zigzagged into each other in every conceivable manner.

Down one side of the gullies, up the other, and over the ridge into the next, we were obliged to climb, sometimes creeping along a narrow causeway between two blue crevasses, till one or the other became narrow enough to enable us to jump the sledge across it. Frequently we cut steps in the ice, and lifted the sledge bodily and almost vertically. Higher up came a smoother slope, broken into terraces; above the terraces a few rounded hummocks; and then a labyrinth of sharp ridges of flinty blue ice, crevasses, V-shaped gullies, and cañons 40 ft. to 50 ft. deep. Up the sides of these we cut steps for ourselves, and fixing an alpenstock at the top, hauled the sledge up with a light double fall of braided linen sash cord. Finally we got the "Sweetheart" up to the top of the ice-tongue, and leaving her anchored to an alpenstock, 1,955 ft. above the sea level, began our descent, reaching the tent before noon. The night was perfect, not a cloud in the sky, and the temperature just below the freezing-point. The next night we carried the second sledge, which we christened "Princess Thyra," in honor of Denmark's youngest princess, up from the ice-foot, and in the morning the "Sweetheart" and the "Princess" lay side by side upon the "ice-blink." After a hearty meal, we lay down under the lee of the sledges, but the wind and the blinding sun made sleep an impossibility. The masses of black rock beyond the margin of the "ice-blink" were tremulous in the dazzling glare; the blue fjord far below us glistening in some places like burnished, in others like frosted steel; and over and beyond the mountains, Disco Bay lay blue.

At eight P.M. the snow having hardened, Maigaard and I started due east* up the "ice-blink," while Frederick re-

* My course throughout the entire journey was east *true*, and I was compelled to make but one detour, recovering my course on the opposite side of the obstacle.

turned to the tent. As we started, the blue of Disco Bay was blotted out by a bank of pearl-white fog, which crept through the narrows, slipped over the mountains at the mouth of the fjord, and crept down their eastern slopes in feathery sprays of silver upon jet. A little later a mass of black clouds hid the sun, and at midnight the fog blotted out the land behind us. At one A.M. it overtook us; the suddenness with which it blotted out every thing and shrouded us in gray nothingness was startling. We kept on till the fog changed to sleet, and the wind increasing, I called a halt 3,000 ft. above the sea. Turning the sledges upon their sides, and placing our rubber pillows and blankets in their lee, we lay down. By this time the wind had become a gale, and the sleet, changed to snow, was driving in a continuous sheet over the tops of the sledges. We were obliged to make a small house for our alcohol stove out of the provision tins, then we drank our tea, lying flat behind the sledges all the time, and turned in. The surface of the "ice-blink" up to this point (about ten miles from the margin), consisted in general of rolling hummocks, extending nearly north and south, highest and steepest on their western slopes, which ranged from 100 ft. to 150 ft. high. The western faces of the hummocks nearest the land were grooved and crevassed, and studded with the huge shark-tooth pinnacles. In detail, the surface was, as a rule, roughly granular in texture, affording firm, sure footing, interrupted here and there by crevasses, some open, and some covered with a snow arch by patches of soft, deep snow in the depressions between the hummocks, and by patches of hard ice cut by nearly parallel furrows, as if made by a huge plough.

We lay behind our sledges, which with ourselves were soon buried in the drift, until late in the afternoon of the second day, when the steady roar of the storm broke into intermittent squalls, and crawling out we got momentary glimpses, behind and below us, of a dense mass of clouds, black beneath and dark dull lead color above, hurrying northward just above the summits of the land. The land itself, hoary in its elevated portions with the newly fallen snow, lay everywhere else as black as midnight, and the fjord had become a pool of ink. Ahead of us, a pale supernatural glare rose nearly to the zenith, and in every direction the "ice-blink," swept by furious snow squalls, and its inequalities obliterated in the shadowless light, stretched dead and silent. At six P.M. the clouds growing blacker and blacker every moment, and every indication pointing to a protracted storm, I decided to take the instruments, and go back to the tent and await more favorable weather. A little more than two hours of steady snow-shoeing down the slope, brought us to the brink of the ice-tongue overlooking the ragged descent through the crevasses and gulches to the ice-foot. At this level, rain had fallen, instead of snow, and the edges of the crevasses, the sides of the gullies, and the hard blue pinnacles were like oiled steel. Having left our ice-creepers on the sledges, we could do nothing but climb over the crest of the mountain dam and down the cliffs and slippery rocks of the other side, to the valley. Here we forded the glacier river, and at midnight reached the tent, the rain falling in sheets, the wind dashing first up, then down the valley, threatening every moment to level the tent, and the glacier river a roaring torrent. Truly, the inland ice had given us a savage welcome, but we were not yet done

with it. The storm continued during the next three days, but on the afternoon of the fourth day, July 5th, bits of blue sky were visible, and at three P.M. we again started. At ten P.M., thanks to our snow-shoes, without which we never should have succeeded,* we reached the sledges. The soft newly fallen snow covered the entire surface of the "ice-blink," except in the lower portion, where the precipitation had been nearly if not quite all rain; and the patches of soft snow encountered on the first trip were deeper, and, with the exception of the upper few inches, saturated with water. In the immediate vicinity of the margin of the "ice-blink" I noticed two entirely distinct appearances of the surface, one consisting of thin, broad, leaf-like crystals, forming a covering about an inch thick over firm dry ice, the other having the appearance of the finest moss, or the finer kinds of brain coral, and always underlaid by a few inches of slush.

Above the 2,500 ft. level the snow was saturated with water in the depressions, but dry and slightly crusted on the tops of the hummocks. Digging our sledges out and freeing them of snow we reloaded them, ate a hearty supper, and at midnight started due east again. During our climb from the ice-foot to the sledges, the coast mountains and Disco Bay had been overhung with great fleecy

* In the preparation of my equipment I had given the utmost care and attention to the foot-gear, and to its excellence and variety my entire advance was due. With my clothing it was entirely different. Misled by Nordenskjöld's experience, I made no preparation whatever, wearing ordinary clothes. Had it not been for the thoughtful kindness of Governor Juncker of Ritenbenk, who insisted on my taking his sealskin jumper, I should have suffered to the verge of actual freezing. As it was, while on the "ice-blink," I was never comfortable when the wind was blowing with any force, and even Maigaard with his double dog-skin and seal-skin jumper and dog-skin sleeping bag passed many an hour made disagreeable by the extreme cold. Nothing short of fur and the impervious integument of animal skin will keep out the searching wind of the "ice-blink."

clouds, remnants of the storm, and the summit of Disco Id. was capped with clouds. Now, however, not a cloud was visible, and the wind was freshening every moment from the east.

North and east the surface of the ice was higher, and the swells apparently longer and flatter than those already passed. Southeast lay the great feeder basin of the Jacobshavn Glacier stretching eastward into the "ice-blink," like a great bay, and up through its centre, like a tide rip in a smooth sea, glistened the ragged points of the glacier itself. Just previous to starting, while walking near the sledges without snow-shoes or alpenstock, I broke into a narrow crevasse, and as I hung for an instant supported by my outstretched arms, before scrambling out, the fragments of the treacherous snow arch went rattling down the azure depths till the echoes they awoke were like the chimes of silver bells. Our snow-shoes prevented a repetition of the occurrence in crossing the network of crevasses which extended east from our camp. As we advanced these disappeared, and in the cold of the early morning the entire surface became one firm unbroken crust, affording excellent walking. Two or three small ponds which we met were frozen just hard enough to support us as we half slid, half skated rapidly across on our "skier," (snow-skates). While crossing another, Maigaard followed me too closely; the ice, cracked and weakened by my passing, broke, and let the "Princess" through in some five feet of water, and it was only with the utmost difficulty that we got her out and to the bank again. This mishap, and the wind now increased to a gale dead ahead, brought us to a halt in a hollow 3,300 ft. above the sea, and we turned in in the lee of the sledges for a few hours' sleep,

after which we spent the day drying our foot-gear and Maigaard's sleeping gear, saturated by the accident and frozen stiff. The lowest temperature during this march was 28°. The wind blew fiercely all day, and the warmth of the sun formed a layer of coarse wet snow three to four inches deep. Beneath the snow the ice was apparently unbroken, assiduous probing with an alpenstock failing to detect any crevasses or water cavities. As soon as the sun got round to the northwest, and the snow had hardened sufficiently to support the sledges, we strapped our snow-shoes on and started again. We soon reached a long narrow lake stretching across our path far to the right and left, and not yet frozen hard enough to support us. To flank this lake cost us a detour of two miles, and even then we were compelled to wade through the morass of water-saturated snow, which surrounded it and extended still farther on either side, our snow-shoes being useless in the semi-liquid slush. Soon after midnight we were able to dispense with snow-shoes, the snow surface being firm and coarsely granular, with occasional small patches of snow of marble-like fineness and whiteness, souvenirs of the last storm; and later, frequent areas of glazed snow, of such hardness that even the brads in our sandals and the steel-shoes of the sledges scarcely left a trace. Again the morning gale brought us to a standstill 4,100 ft. above the sea, the entire surface of the "ice-blink," as far as we could see, glazed and shining beneath the morning sun, with a blinding brilliancy impossible to describe. The lowest temperature during this march was 25°, and the sky cloudless except a few delicate cirrus feathers, stretching east and west. Taught by our experience at previous camps, that it was impossible to sleep

exposed to the powerful glare of the sun, and the searching sweep of the wind, and having at this camp suitable material, we built a rough hut, cutting blocks of snow with a long, narrow-bladed saw, and building a low wall around three sides of a rectangle, over which we spread a rubber blanket and weighted it down with the sledges.

During the next march we passed, at an elevation of 4,500 ft., an upheaval of the ice, extending in an irregular ridge from 6 ft. to 15 ft. in height, and about a mile in length, northeast and southwest. Deep cracks ran along the crest, and others radiated from the higher points, just as the ice in a river or pond cracks and bulges upward when a fall in the water allows it to bear upon the rocks beneath. North of this ridge lay a smooth and perfect bowl-shaped basin some 50 ft. deep and one half mile in diameter, with other upheavals along its farther edge. At five A.M., from top of a swell 4,600 ft. high, we saw the last land, the tip of one of the Noursoak Mountains, showing a speck of rose above the blue snow horizon. The top of the next swell, 100 ft. higher, was thickly covered with fine sastrugi and dainty scallop-shells of snow, the size of the hand, all with the concave side down, giving the surface the appearance of being ruffled into wavelets by a stiff breeze. The wind, as usual, blew freshly in our faces all night, increasing in strength as the sun reached the east. Two or three clouds, which lay in the southeast when we started, kept increasing till they covered half the sky. Far up the most delicate cirrus clouds hung motionless, while the others drifted rapidly beneath them. Two or three very dense banks loomed up from the southeast as if for snow, but finally broke to pieces. Lowest temperature during the night was 28°. The house here was

much more difficult to build than the other, the snow being interspersed with layers of tough transparent blue ice from half an inch to one inch thick, and very difficult to cut, even with the saw. It was late before the snow hardened, and when we started the southeast wind was bringing up dark clouds, which soon covered the entire sky. At two A.M. a dense cold fog enveloped us, turning an hour later into a fine drizzling rain. The sledges sank till the entire bottom dragged, the wet snow clung to them, and clogged our snow-shoes, till travelling became too laborious, and we halted. The following day it was very warm during the forenoon, and peculiar opaque white clouds covered the entire sky like a thick coat of enamel. Curiously enough, these clouds seemed to intensify the glare from the snow, and make it (if I may use the word) suffocating. Later they disappeared, and the sun shone brightly. The temperature still remained high, and as the snow did not harden at night, and both Maigaard and myself were tired, we decided to stop here one day and rest and put our foot-gear in order.

The next afternoon, for the first time since we came on the ice, it fell perfectly calm. In less than an hour after we took up our line of march again we reached an altitude of 5,000 ft., and stopped a moment to drink a health to the "Sweetheart" and the "Princess." A little before midnight we ascended a swell on which the barometer said 5,300 ft., and found it traversed by six parallel crevasses spaced about 100 yards apart, and extending north and south as far as we could see. The first one was about 15 ft. in width, the snow which covered it being depressed about a foot below the surrounding surface. The others were narrower. Far to the south the edges of all seemed

to be ragged and broken, and the snow arches fallen in. Testing the arch before us with an alpenstock, and finding it apparently strong enough, we rushed the sledges rapidly across, and went on. Our lunch was eaten at an elevation of 5,500 ft., and when we resumed the march the wind, almost imperceptible when we left camp, blew very fresh in our faces; the temperature was $18^{\circ}.5$, and our snow-shoes were discarded. At six A.M. we halted in one of the broad troughs between two swells, the wind blowing a gale, and the temperature 19° . The snow here was too hard to cut, and we were obliged to turn in on the sledges. In our next march we reached at 1:30 A.M. an altitude of 6,000 ft., and again drank the health of the "Sweetheart" and the "Princess." A few moments later a dense white fog enveloped us, and in an instant clothes and sledges were coated with milk-white ice crystals. The temperature was 16° . This fog enveloped us about two hours; then passed away to leeward. Before we halted, however, we passed through two more banks of it. The elevation of our next camp was 6,200 ft. At one A.M. on the next march we reached an elevation of 6,500 ft., and at two A.M. the thermometer stood at $8^{\circ}.5$. Fortunately, the atmosphere was comparatively still, otherwise we would have felt the cold severely. The wind was light, the sky partly covered with light, veil-like clouds; the snow crackled beneath our feet, and sparkled in the frosty air, as if sprinkled with myriad gems. In spite of the low temperature, however, the crust lacked the firmness which it had at lower elevations, frequently letting us break through, and the snow was dryer and finer. From three A.M. till four A.M. a brilliant parhelion filled the northeastern sky with rainbow hues, and elicited answer-

ing flashes of color from the glittering snow-field. We put on our snow-shoes before beginning our next march over the then weak crust, and during several succeeding days they were off our feet only when we were in our sleeping bags. The fierce east wind during this march made the temperature of 10° almost unbearable. Every bit of metal stuck to our fingers or lips, and boiling tea was cold almost before we could get it to our mouths. At three A.M. we tallied 7,000 ft., and at six A.M. went into camp at an elevation of 7,200 ft.

A can of beans, which with tea formed our supper, had to be chopped in halves with the hatchet, and its contents extracted and eaten with the same implement. My internal economy took exception to this frozen ration, and unable to sleep, I passed the time drying and mending my foot-gear, and improvising mittens out of some spare socks. At noon the wind had moderated, but later it came very fresh from the southeast, bringing up heavy clouds, which, when we began our next march, covered the entire sky. Just after midnight we got a dash of fine rain, and at two A.M. it began to snow, the wind blowing with increasing violence from the southeast. We advanced against this storm till six A.M., when we camped at an elevation of 7,450 ft. It was impossible to build a house from the dry, incoherent snow at this camp, and we were again compelled to turn in behind our sledges. The day passed with alternating bursts of sunshine and snow-squalls, which whirled and eddied about the sledges, and in spite of our utmost efforts, drove the fine snow into every corner of our sleeping bags. When we resumed our march on the 15th, the wind had settled down to a steady southeast gale loaded with snow; and against this

we advanced with goggles on, hoods pulled up, and heads down, keeping our course by the wind, until the sinking of the sledges in the soft snow, and the continual clogging of our snow-shoes, compelled us to halt and wait the cessation of the storm. The lowest temperature during the night, 21° ; elevation of camp, 7,525 ft. Too tired and sleepy from our struggle with the storm to build a house, even had the loose snow rendered it possible, we turned in behind our sledges and immediately went to sleep. When I awoke we were completely snowed under, and here we lay for forty-eight hours with the wind and snow driving in one incessant, sullen roar across the drift above us; crawling out but once to make some tea and get the cramp out of our limbs. This proceeding we both regretted, as the fine snow was driven into every fibre of our clothes, and when we crawled down into our dens again, it melted, turning our comparative comfort into cold, wet misery. Sunday morning we crawled out during a lull in the storm, and dug a shallow pit, covered it with a rubber blanket, excavated our sledges and bags, placed the sledges on the blanket, threw our bags underneath, and crawled after them. A pint of hot tea each, and a square meal, made us feel as if we were the proprietors of a palace, and though the storm raged twenty-four hours longer, we were comparatively comfortable.

About five A.M., Monday the 19th, a narrow ribbon of crystalline blue appeared beneath the clouds in the south-east, and widened and grew until it reached the sun. Then followed a perfect day, warm, clear, almost calm, enabling me to get a good observation, and permitting us to dry all our gear. Our camp, 7,525 ft. above the sea, and within a fraction of one hundred miles from the margin of

the "ice-blink,"* lay in a shallow basin, the snow previous to the last storm, of the consistency of fine granulated sugar, as far down as I could force my alpenstock (some six feet).

We had six days' provisions left, and being uncertain as to the changes in the lower portion of the "ice-blink" during our absence I decided to return. We lashed the "Sweetheart" and the "Princess" together, an extra pair of snow-shoes serving as cross-bars, improvised mast and yard from our alpenstocks, and sail from a rubber blanket; and late in the afternoon we had as big, strong, and flexible a little catamaran as one could wish to see; the black sail, yellow spars and hulls, red sailing pennant, and the flashing tins of the load, forming a vivid contrast to the

* This distance is based on an excellent series of twelve circummeridian sights at this camp, with the theodolite placed within the walls of our hut to protect it from the wind; a series of ten similar sights at the tent; and time as given by one of the best Elgin watches, carried, during the five days intervening between the observations, in a pocket on the inside of the bosom of my flannel shirt. Having carried the watch two or three years, I know its variation in that time could by no possibility exceed thirty seconds either way. For several reasons no other observations are given.

In the selection of my instrumental outfit, I had chosen a light, traveller's theodolite, as being lighter and more generally useful than a sextant and artificial horizon. But under the conditions of continuous wind and deep snow which I encountered, it was impossible to use the theodolite except by setting it in the compacted bottom of a snow-house after we had slept in it, with the wall of the hut to shield the instrument from the wind.

In scaling the glacier face, my chronometer had had the usefulness shaken out of it, and after this loss I did not feel disposed to add the labor and discomfort of observations of approximate value only, to the constant and imperative demands of the numerous details, attention to which was the price of our advance. My daily advances were only estimated, and therefore I do not present the distances.

The elevations are those indicated by one of Keuffell & Esser's best \$26 pocket aneroids, with attached thermometer and compass. The ascent on the outward trip, as shown by this barometer was 7,525 ft., the descent on the return (one hundred and thirty-three hours of continuous fine weather), 7,450 ft. Mean, 7,487 ft. 6 in.

Temperatures were shown by a Signal Service thermometer.

unbroken white expanse of the "ice-blink." At six o'clock at night we started on our return beneath a cloudless sky, the wind southeast and light. At first the sledges sank in the snow till the full width of the bottoms dragged, but about midnight the wind changed into the east and freshened, the snow became somewhat firmer as we descended, and the sledges began to crowd us and run upon the heels of our snow-shoes, so we dropped the drag-rope, and each taking a projecting end of the alpen-stock which formed the yard, travelled beside them. In spite, however, of the relief from dragging the sledges, the travelling during this night was extremely trying, patches of fine snow of chalky whiteness, into which our snow-shoes sank deeply, alternating with glazed surfaces so hard and slippery it was almost impossible to keep our snow-shoes under us, and sastrugi, firm and white as if carved from marble. Over these sastrugi the sledges would have travelled like the wind, while we could only hobble along, getting a tumble every now and then. A peculiar phenomenon noticed during this march was the apparent sinking of large areas of snow at intervals as we passed along, accompanied by peculiar muffled reports which rumbled away beneath the crust in every direction until they died away; just as happens when one is skating upon a freshly frozen lake in early winter. The sky above was flawless blue, the crimson sun in one direction, the yellow moon opposite, and the plain on which we travelled spread with diamond dust. At midnight the northern sky was a sea of crimson light, and the snow lay bathed in delicate shades of rose. When we halted at five A.M. the aneroid showed a descent of 650 ft. All day long on the 20th the east wind blew, and when we

started again the sledges went merrily along before it, requiring no exertion on our part other than to guide and restrain them. At first we encountered the sastrugi and alternating patches of soft snow and slippery ice as on the preceding march, but when we reached an altitude of 6,000 ft. these all disappeared, and the snow was covered with a thin, uniform, coarsely granular crust over which the sledges would have dashed with great rapidity had we loosed our grasp upon them. As we continued to descend, the crust on some of the slopes became firm enough to allow one of us to ride, while the other travelled behind and guided the sledges. During this march we descended 950 ft., and sky and snow were again brilliant with indescribable splendor. Not a cloud was visible except, at a great altitude, two or three delicate motionless "mare's tails," the banners of the wind. The snow dust raised by our snow-shoes went hurrying along before us in two long sinuous lines of pale rose-tinted smoke, twisting and waving like spirits of the ice at play. The lowest temperature during the march was 18° F., and when we halted the wind was howling like a demon past the sledges. After rigging a rudder (a hatchet lashed to the end of a snow-skate) to the catamaran, we turned in on the sledges. At this camp we succeeded in melting snow in a rubber blanket shielded from the wind, and for the first time in ten days had an unstinted drink of water. The wind continued without cessation, but it was late before the crust was firm enough to support the sledges. Every moment, however, the biting wind made it firmer, and as the yellow sun stooped to the northern horizon Maigaard and myself took our places upon the sledges and began a bit of travelling, which as far as I know has

no parallel in Arctic work. From midnight till five A.M. we sped along, taking the levels at the speed of a fast walk, and dashing rapidly down the inclines, the hatchet rudder working admirably.

At five A.M., having descended 1,250 ft., a series of broad white bands on the top of a swell below and ahead of us made us get off and walk the sledges up to reconnoitre. Just as we rose on the swell enough to make out that the white bands were a group of enormous snow-covered crevasses across our path, the land Noursoak and Disco, dark and half shrouded in haze, leaped up from the white expanse below us with a suddenness that was absolutely startling. I had expected to see the land before we went into camp again, but imagined it would appear gradually, the same as it had disappeared on the outward trip, instead of flashing into sight in this manner. The explanation of this, I soon discovered, was that during the preceding five hours, while sitting upon the sledges and steering a course by the sun (the motion of the sledges rendering the pocket-compass useless), the fear of falling off to the south into the basin of the Jacobshavn Glacier had unconsciously made me keep up to the north too much, and I was now about four miles north of my outward route and considerably higher. The crevasses, the most magnificent ones we had seen, were many of them 50 ft. wide, and the group was about half a mile across. As a rule, they were covered by snow arches, though in several places these had fallen in. Not caring to make a detour, and the snow arches being apparently strong, we rushed the sledges over, taking flying steps and half supporting ourselves on the yard of the catamaran as the wind and the impetus of

our run hurried us across. The edges of all the openings into these huge chasms had an overhanging lip of snow, making it impossible to approach them to sound or look down. We could only get hasty glimpses into them as we passed over the snow arches, and these showed that their ragged blue walls, hung with giant icicles and frost work of fantastic patterns, descended into depths of blue black night.

Beyond the crevasses the descent was very rapid and jumping; on the sledges again we began an exciting run. The wind straining the sail till it threatened to tear it from the mast, and the rapid descent together, drove us down the frozen slope with a breathless rush, which only those who have been on a toboggan can understand. After dropping 300 ft. the descent became less rapid but the crust was more icy, and we dashed rapidly along for an hour, the supple catamaran gliding over the snow, and rising and falling to every inequality with sinewy ease and grace.

There are two who will not soon forget that glorious dash down the slope of the eternal ice in the crisp air and rosy light of that Arctic summer morning. At the end of an hour we had descended 600 ft. and as we dashed over a hummock and started down its western slope, a lake of deepest ultramarine flashed into view beneath us. Hauling the catamaran close to the wind we dashed diagonally down the slope and just cleared the end of it. Beyond here every depression was occupied by a blue pond, often hidden by the hummocks until we were almost into it, and we were compelled to get off the sledges, take down the sail, and walk until we were stopped, shortly after eight A.M., by a broad

morass of slush and water extending right and left as far as we could see.

The total descent during this march was 2,125 ft. On the southern slope of some of the hummocks in this region of ponds, the snow had melted into a conglomeration of rounded ice pellets the size of marbles, while on the northern slopes it still remained smooth and white. On several of the steeper hummocks large areas of the snow on the sides had slid down to the bottom, leaving the underlying ice bare. The ice thus exposed was at a little distance indistinguishable from the ponds, both being of the deepest ultramarine. The effect of these false ponds lying quietly on the side of hummocks was to give the landscape of the "ice-blink" a peculiar, topsy-turvy, unreal aspect. The snow where we halted was a mass of heavy slush, and, after lying awake till noon to get a meridian observation, I turned in on the sledge with smarting face and eyes feeling as if bathed in fire, the wind threatening to pick us up bodily and hurl us into the swamp ahead.

Here we remained until midnight, waiting for the surface of the morass to freeze sufficiently to support us. Scarcely 50 yards from camp, however, we found the ice too weak even for snow-shoes, and we sank to our knees, the shoes coming up loaded with slush, at a temperature that needed but a touch of the air to make it congeal. To make a detour in the face of the wind was an impossibility, and after a little reconnoitring we started straight across the morass, the sledges sometimes entirely submerged, plowing through the slush, and leaving a broad trench behind them which immediately filled with water, forming a canal that would have floated

a whale-boat. Fortunately, the depth of the slush and water did not exceed three feet, and fording the stream which ran through the centre of the morass, we at last emerged upon dry ice, and clearing the sledges of their load of slush, started on the run to restore sensation to our feet. During the next seven hours these half-frozen morasses alternated with hard blue ice honey-combed with water cavities. The latter made very rough and semi-dangerous travelling for Maigaard and myself, though the sledges under reefed sail glided along almost as smoothly as on a newly frozen pond, supporting and even dragging us along when our feet went into the holes. Then the character of the ice changed completely, the slush and water cavities disappeared, and the entire surface consisted of a white granular snow-ice scored in every direction with furrows one to four feet deep, and two to eight and ten feet wide, with a little rill at the bottom of each.

The tops of all the hummocks were also traversed by more or less numerous crevasses, not sufficiently wide, however, to give us much trouble. But the furrows were very severe upon us, wrenching arms, back, and legs with the constant pushing, pulling, lifting up and easing down, and pounding the sledges continuously, as they pitched from the top of one ridge upon the slope of the next or into the ditch between them. Besides this, our feet were kept constantly wet by the brooks. As the sun gained in altitude a light mist in the fjords and valleys brought out the features of the land distinctly, and I could make out Illartlek, though the pass by which we had ascended was still hidden below the round of the "ice-blink." From here on the travelling

was rougher than ever, being a constant succession of up hill and down, with rivers in the valleys, crevasses on the summits, and the muscle-straining furrows on the slopes, each of these features growing bolder and more pronounced as we got lower and more within the disintegrating influence of the heat reflection from the land. One of the crevasses, covered by a light snow-arch, came near robbing me of my friend. We had pushed the catamaran across, as was our custom, till it rested at each end on the opposite edges of the chasm, and had jumped across to pull at the same instant that Maigaard pushed. Unfortunately, he tripped as he sprang after, stepped heavily upon the snow-arch, it gave way beneath him, and clinging to the stern of the catamaran, he sank into the crevasse, while the bow shot into the air with a jerk that nearly tore it from my grasp. For a moment the sledges hung tilted on the lip of the chasm, with a man's life hanging on their quivering forms; then the bows descended, and Maigaard's head came up to the surface level; the sledges crept farther into the ice till the long arm of the lever was in my favor, and Maigaard, pale but smiling, swung himself up on the ice with a careless "ayungilak" (all right). A little farther on I came in for a disagreeable though harmless experience. Having stepped down mid-thigh deep in a glacier stream to lift the "Sweetheart and the "Princess" across, the current swept my feet from under me, plunged me into a deep hole just below, then rushed me along between the polished banks with a noiseless velocity which almost made me dizzy. I was beginning to get irritated at my utter helplessness in this stream, scarcely more than six feet wide or more than five feet deep, when a shallow place

gave my spiked sandal a point of application for a spring against the steep bank up which I scrambled, and ran to help Maigaard, who was barely able to hold the half-submerged sledges against the current. It would have broken both our hearts to have lost them now. We kept on until one P.M., when, tired with the severe work of the last thirteen hours, we halted in the fork of a stream 3,000 ft. above the sea, and turned in. The pain in my eyes, together with my cracked and blistered face, and the condition of my hands, severely cut by the sharp ice in emerging from my bath, rendered sleep an impossibility for me.

Resuming our march when the sun was in the northwest, we found the furrows and crevasses increasing in number and width as we neared the land. After the sun rose from its short dip below the northern horizon, we forgot every thing in the splendor of the morning. The wealth of deep, rich coloring among the dark mountains below us was wonderful, and through their massive portals we caught glimpses of the deep blue of Pakitsok and Kangendluarsarsoak fjords, and farther away Ikaresak Sound. Behind us the yellow sun floated along above the steel-blue line of the frozen horizon through a sea of liquid fire. At three A.M. we reached the edge of the ice-tongue, anchored the sledges, and with the instruments rolled up and slung on my back began the descent of the glacier face, and reached the ice-foot at five A.M. In this descent was concentrated about all the real peril and danger of the entire trip. All the more salient features were the same as when we made the ascent three weeks before, and we could easily trace our upward route, but those three weeks of Arctic summer

had transformed every inch of surface into solid glistening, unctuous blue ice, and every detail was sharper, deeper, more angular, more heavily accented, like an etching longer exposed to the acid. Ridges which then were broad enough to permit a sledge to pass with a man on each side were now mere knife edges; crevasses that could be jumped then were impassable gulfs now. With only a short theodolite tripod to serve as alpenstock for both, we picked our way down, traversing the crests of some of the ridges, as slaters walk the ridge of a house, and sitting astride of others and sliding along. Once Maigaard, in reaching for the tripod which had fallen from his grasp, slipped, fell on his back, and went shooting down a steep slope, stopping himself with his spiked heels just on the brink of one of the yawning blue crevasses. As we went down the valley we found a new tribe of flowers had made their appearance during our absence. In some places the sod was covered with large purple blossoms, and delicate bluebells were abundant everywhere. The heat in the valley even at this early hour was oppressive to us, accustomed to the cold atmosphere of the "ice-blink," and when we reached the tent at seven A.M., I was carrying about all my wearing apparel except foot-gear slung at my back. Two days later my eyes and face had regained something like their normal condition, and we packed the sledges over the mountains and down to the tent on our backs, and returned to Ritenbenk. Here much to my regret I was obliged to part with my tawny-bearded, blue-eyed friend Maigaard, and go on alone to the Torsukatak Glacier and the base of Noursoak Peninsula. All my foot-gear was much the worse for wear, and I knew that whatever I might be able

to accomplish now would have to be done literally single-handed, as the natives would not go on the ice, yet I could not rest till I had examined the ice behind the peninsula. Lack of space forbids any description here, but my trip over the "ice-blink" from Torsukatak Glacier to great Kariak Glacier, and my examination of the coast line of the "ice-blink" across the base of Noursoak Peninsula were to me extremely interesting. After spending nine days in this work I returned to Kekertak, visited the fossil beds of Atanekerdluk, thence to Ritenbenk, then across the Waigatt to Ujaragsugsuk on Disco Id., and along the coast of Disco back to Godhavn. Sept. 6th I went on board the *Eagle* again, and crossing Baffin's Bay to Dexterity Harbor, just N. of Cape Cargenholm, worked thence down along the west coast to Cumberland Gulf, and from there to St. John's arriving at the latter place Nov. 17th.

The characteristics of such portions of the "ice-blink," as came under my personal observation, may be stated as follows. The coast line shows a great diversity of features, dependent upon the altitude, the season, and the elevation and configuration of the adjacent mountains. Wherever the ice projects down a valley in a long tongue or stream, the edges contract and shrink away from the warmer rocks on each side, leaving a deep cañon between, usually occupied by a glacier stream; and the upper surface, disintegrated by the reflected heat from the mountains above, and shattered by the daily change of temperature more perhaps than by the forward flow, presents a chaotic labyrinth of crevasses, gullies, and ragged pinnacles, increasing in magnitude in direct proportion to the length of the tongue and its approach to the sea level.

Smaller tongues or teats, rounding down into shallow indentations in the crest of the mountain dam, are apt to have only their tips ragged and their upper surfaces covered with a net-work of narrow crevasses. Higher up, along the unbroken portions of the dam, where the rocks have a southern exposure or rise much above the ice, there is apt to be a deep cañon between the ice and the rocks; the ice-face sometimes 60 ft. high, pure, pale-green, and flinty. In another place the ice-face may be so striated and discolored as to be a precise counterpart of the rock opposite, looking as if torn from it by some convulsion. The bottom of the cañon is almost invariably occupied by water. Where glacier streams find an exit through the crest of the dam, and there are no adjacent rocks higher than the ice to push it back with their reflected heat, the ice will reach down upon the rocks in a dome-like slope. Frequently drifts of fine hard snow extend like causeways from ice to rock, through the bases of which the littoral glacier streams tunnel a passage. Still farther up, at the very crest of the dam, the ice lies smoothly against the rocks. As to the features of the interior beyond the coast line, the surface of the "ice-blink" near the margin is a succession of rounded hummocks, steepest and highest on their landward sides, which are sometimes precipitous. Farther in, these hummocks merge into long flat swells, which in turn decrease in height towards the interior, until at last a flat, gently rising plain is reached, which doubtless becomes ultimately level.

In passing from the margin of the "ice-blink," to the remote interior, from one to five distinct zones may be noted, the number and width varying with the season,

the latitude, and the elevation. In winter the entire surface is undoubtedly covered with a deep unbroken layer of fine dry snow. Late in the spring, the warmth of the sun at mid-day, softens the surface of the snow along the low borders of the ice, and this freezes at night, forming a light crust. Gradually this crust extends up the interior, and with the advance of the season, the snow along the borders of the "ice-blink" becomes saturated with water. A little later this zone of slush follows the zone of crust into the interior, the snow along the borders of the "ice-blink" melts entirely, forming pools in the depressions, and streams which cut deep gullies in the ice; water cavities form; old crevasses open, and new ones appear. This zone rapidly widens and extends into the interior in the footsteps of the others, and behind it the immediate border of the ice gets ragged and soiled, pebbles, boulders, and moraines crop out of its melting surface, and by the end of the Arctic summer it is eaten and shattered by the heat, and eroded by the streams, into impassable roughness.

1st. In any attempt to penetrate to the interior, the "ice-blink" should be attacked at some point as far above the level of the sea as possible, rather than the reverse, as has hitherto been done. It is infinitely easier to get sledges, etc., a thousand or even two thousand feet up the mountain on the back, even though the ascent be nearly vertical, than by attacking the "ice-blink" near the sea-level, to lift and drag them over miles of ragged ice and across innumerable crevasses before reaching an equal altitude.

2d. A place should also be chosen, if possible, where the presence of large and rapidly discharging glaciers indicates a rapid ascent to a highly elevated interior, in close proximity to the coast.

3d. Hudson Bay sledges must be used, and every member of the party must be perfectly at home on both snow-shoes and "skier" (snow-skates).

To a small party thus equipped, and possessed of the right mettle, the deep, dry, unchanging snow of the interior is not a *bête noire*, but something to be reached, as noted above, at the earliest possible moment, and once reached, it is an imperial highway, over which a direct course can be taken to the east coast, and from the heights of the "ice-blink," or the summits of its mountain dam, with miles of the coast lying like a map below, as I saw the entire circuit of Disco Bay, and, at another time, Noursoak Peninsula, Omenak Fjord, and Svarten Huk Peninsula, it can be charted with an ease and accuracy unknown to one toiling along from headland to headland of the sea-coast.

Such a party, in a series of explorations from different points of the Baffin's Bay and Smith Sound coasts, could, in case the "ice-blink" is coextensive with the northern coast, fill out the incomplete coast-line, fix its northeastern limit, an achievement second in interest only to the discovery of the Northwest Passage and the North Pole, and complete our knowledge of Greenland.

To speak more in detail, the first step would be to cross from the base of Noursoak Peninsula, to the head of Francis Joseph Fjord, on the east coast, and return. Then, with the experience thus gained, start from Whale Sound, and keeping sight of the land, follow the margin of the "ice-blink" either into the northeast angle of Greenland or to its intersection with the east coast in a lower latitude, as the case may be. This route I believe to be the key to the solution of the Greenland problem.

If to the above be added a profile from Disco Bay south-east to Cape Daw, nothing would remain but minor details.